July 23, 1940. W. F. RURUP 2,208,775

AUTOMATIC BYPASS VALVE FOR OIL WELL PACKER

Filed May 9, 1939 2 Sheets-Sheet 1

Fig. 1

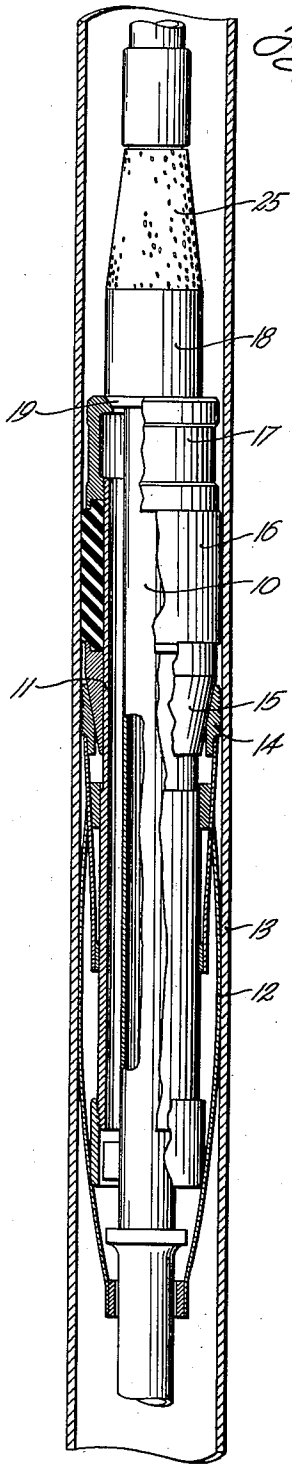
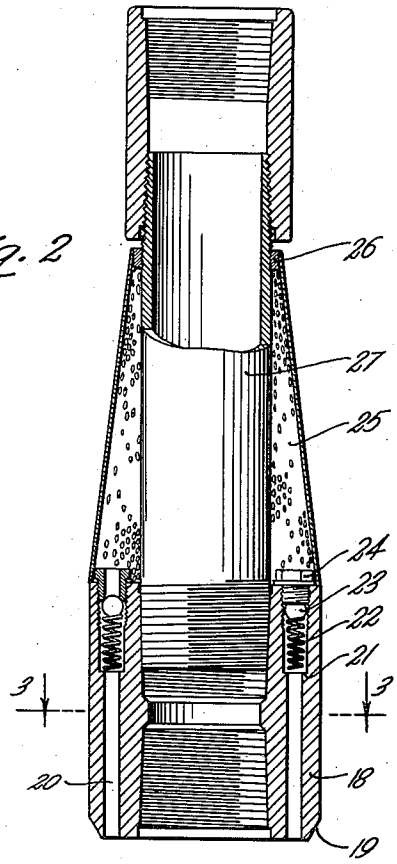


Fig. 2



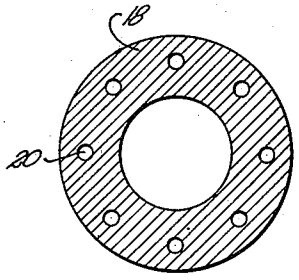


Fig. 3

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AUTOMATIC BYPASS VALVE FOR OIL WELL PACKER

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Fig. 4

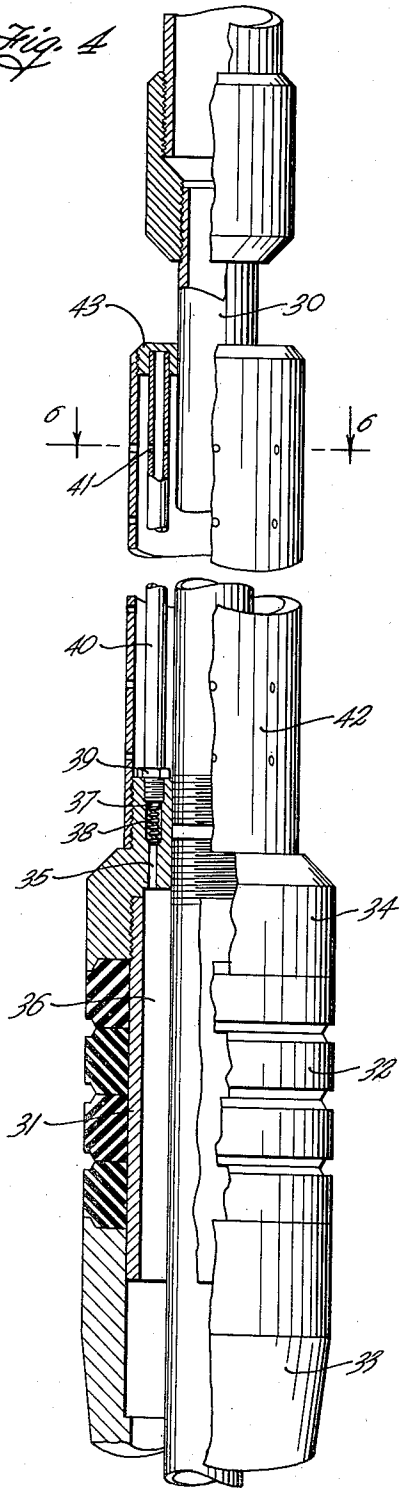


Fig. 5

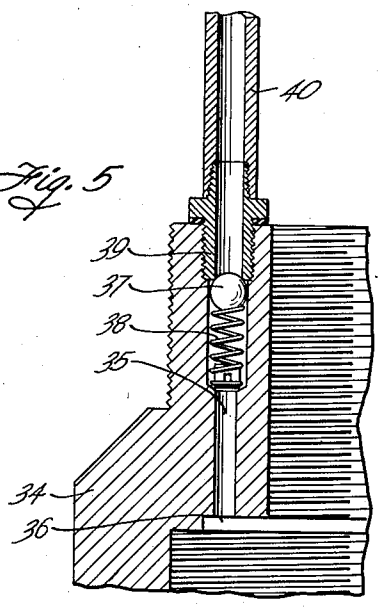
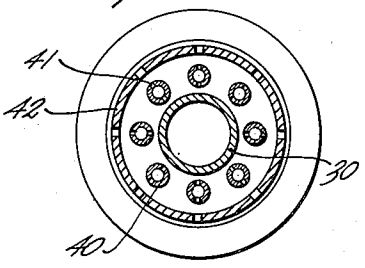


Fig. 6



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UNITED STATES PATENT OFFICE

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AUTOMATIC BYPASS VALVE FOR OIL WELL PACKER

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Application May 9, 1939, Serial No. 272,603

12 Claims. (Cl. 166—12)

This invention relates to an automatic bypass packer for use in oil wells, and concerns a method of using the same.

An object of the present invention is to provide a packer for use in oil wells equipped with automatic bypass valves which will permit the downward flow of fluid through the packer around the tubing or passage through the packer, but which will automatically prevent flow in the opposite direction, thus retaining the formation pressure below the packer. In many instances, when packers are installed in wells it becomes desirable to permit fluid to flow from above the packer to below the packer without in any way disturbing the packer. For example, if a well is brought in, thus reducing the pressure below the packer, the hydrostatic pressure developed by the column of liquid above the packer is unbalanced by the formation pressure and must be supported by the packer. Under such circumstances it is desirable to at least partially equalize the pressure above and below the packer or on the outside and inside of the tubing by permitting some of the liquid above the packer on the outside of the tubing to pass downwardly through the packer. In some instances it is desirable to replace the heavy circulation fluid that may be in the well above the packer with a lighter liquid such as oil. The packer embodying the present invention permits such partial equalization of pressure to automatically take place whenever necessary but at the same time it serves to automatically retain the well or formation pressure.

The packer embodying the present invention may also be used advantageously for other purposes than to merely equalize pressures. For example, it may be advantageously used to start an oil well to flow or in the parlance of oil fields to "kick the well over." When used for this purpose gas may be forced into the well between the casing and the tubing and passed downwardly through the automatic bypass valve expelling the circulation fluid into the tubing with the gas finally following the liquid into the tubing and thus enabling the well to start flowing through the tubing. When the well starts to flow through the tubing the automatic bypass automatically closes to retain the formation pressure and thus causes the well to continue to flow.

The packer embodying the present invention may also be advantageously used in flowing a well by means of compressed gas and may be used advantageously in cleaning sandy wells that tend to sand up below the packer.

Heretofore oil well packers have been devised wherein there is a valve seat above the packing ring or rings with a valve on the tubing adapted to seat thereon and cause the valve seat to compress and expand the packing rings. In such type of packers when the packer is lowered into the hole the valve on the tubing is held above the valve seat so that circulation fluid in the well may readily pass through the packer while it is being lowered to the desired position. On reaching the desired position the packer is set and the valve seated on the valve seat. Thereafter, it is customary to apply the "Christmas tree" to the top of the tubing. If conditions should arise wherein it would be desirable to unseat the valve from its valve seat so as to equalize pressures above and below the packer, this could only be done by removing the "Christmas tree" from the tubing, then lifting the tubing to lift the valve off the valve seat. However, when the "Christmas tree" is removed from the tubing there is constant danger of the well flowing during this period and getting out of control. The present invention is applicable to packers of this type to automatically permit equalization without requiring removal of the "Christmas tree" or a lifting of the tubing to unseat the valve from the valve seat. Consequently, in the present construction equalizing of pressures can take place whenever necessary without endangering the well by the removal of the "Christmas tree."

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a vertical section through a casing illustrating one form of oil well packer as having the automatic bypass valve embodied thereon, a portion of the packer being broken away and shown in vertical section;

Fig. 2 is a vertical section through the valve of the packer shown in Fig. 1, as having the automatic bypass valves incorporated therein;

Fig. 3 is a horizontal section taken substantially upon the line 3—3 upon Fig. 2;

Fig. 4 is a view in side elevation of another form of packer having the automatic bypass valve constituting the present invention incorporated therein, a portion of the packer being broken away and shown in vertical section;

Fig. 5 is a partial view in vertical section on an enlarged scale showing the bypass valve used in the packer shown on Fig. 4; and

Fig. 6 is a horizontal section taken substantially upon the line 6—6 upon Fig. 4.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the invention has been illustrated in Figs. 1, 2, and 3 as having been applied to that type of well packer known in the industry as a Guiberson control head packer, although it will be understood that this type of packer has been shown for illustrative purposes only in these figures and that the invention may be incorporated in or applied to other types of well packers. In order to understand the nature of the present invention and its function with relation to packers of the Guiberson type, a brief description of the Guiberson type of packer illustrated is thought to be necessary.

In this form of construction the tubing is generally designated at 10 and around this tubing in spaced relation thereto there is a sleeve or shell 11. Around the lower end of the sleeve or shell 11 there are friction springs 12 engageable with the interior of the casing 13. These friction springs are releasably held in their lowermost positions by any suitable means, such as a bayonet joint, not shown, while the packer is being lowered into the well. On release of the bayonet joint accomplished by rotating the tubing the sleeve or shell 11 can be lowered relative to the friction springs so that slips 14 can be expanded by the slip cone 15 into engagement with the casing. Above the slip cone 15 there is a rubber packing sleeve 16, or a series of packing rings may be employed, constituting a packing means. On top of the sleeve or shell 11 there is a valve seat 17 on which is adapted to seat a valve which is mounted on tubing 10. When tubing 10 is lowered after the slips 14 have been set the valve on the tubing engages the valve seat, thus closing the packer against flow through the space between tubing 10 and the sleeve or shell 11. At the same time weight of the tubing 10 imposed by means of the valve on valve seat 17 causes the rubber packing sleeve 16 to be compressed and expanded into firm sealing engagement with the interior of the casing. In this way, the upper portion of the well is isolated from the lower portion of the well below the packer except through tubing 10. When the packer is thus set in the well it is customary to apply the conventional "Christmas tree" to the top of the tubing at the surface and as long as the "Christmas tree" remains installed the tubing can no longer be vertically moved to unseat the valve on the tubing from the valve seat 17.

If the well is brought in under these conditions the circulation fluid or mud between the tubing 10 and casing 13 above the packer has its weight supported by the packer. In the case of very deep wells this weight of liquid may be of a very great magnitude. On bringing the well in the pressure within the tubing may become a great deal less than the pressure created by the weight of the circulation fluid between the casing and the tubing. Severe strains are thus imposed upon the packer and upon the tubing tending to cause the packer to leak and in severe cases, tending to cause the tubing to collapse. While it might be desirable to lift the tubing under these circumstances to unseat the valve on the tubing from valve seat 17 and thus permit a portion of the column of circulation fluid between the tubing and the casing to drain through the packer and to this extent reduce the pressure on top of the packer, the opening of the valve cannot be accomplished without lifting the tubing which involves a removal of the "Christmas tree." If the "Christmas tree" is removed, however, under these conditions there is always a danger of the well getting out of control.

The present invention when applied to a packer of the Guiberson type contemplates a valve applicable to the tubing 10 which is designed to seat on valve seat 17 and which provides a bypass that will permit fluid between the casing and the tubing above the packer to pass downwardly through the packer between tubing 10 and sleeve 11 at any time without requiring removal of the "Christmas tree" or any disturbance of tubing 10. Thus, an equalization of pressures above and below the packer or on the inside and outside of the tubing can be accomplished whenever necessary without danger of the well getting out of control. At the same time formation pressure below the packer will always be retained.

The bypass valve forming the present invention as applied to packers of the Guiberson type is illustrated in detail in Fig. 2 and consists of a valve body 18 having a seating surface 19 engageable with the seating surface of valve seat 17. This valve body 18 is attached to or may be incorporated in the string of tubing 10. One or more passages 20 extend vertically through the body and are arranged inwardly of the seating surface 19. The upper ends of these passages are enlarged forming shoulders 21 constituting spring seats for springs 22. The springs 22 urge balls 23 which constitute upwardly closing check valves into engagement with their seats 24 which are screwed into the upper ends of the passages. While the number of passages may vary, I prefer to use an even number of passages such as four, six, or eight, equally spaced around the valve body 18 although it will be understood that the particular number employed is somewhat optional and immaterial.

Arranged over the valve body 18 is a conical screen 25 in the top of which there is brazed an internally threaded ring 26 that is screwed onto a short section of tubing 27. This serves to maintain the screen in place. The function of this screen is to merely screen such fluid or liquid that may pass downwardly through passages 20 so that there will be no danger of the upwardly closing check valves 23 becoming clogged or held open.

There are numerous advantages of equipping an oil well packer with an automatic bypass valve as above described. The following are given as illustrative methods of use, although it will be understood that the use of the invention is not in any way restricted thereto. When the automatic bypass valve is combined with or associated with a packer of the character previously described, the packer may be set in the well in its normal or usual manner. On bringing in the well such as by swabbing through the tubing, if the hydrostatic weight of the fluid or liquid between the casing and the tubing above the packer becomes excessive the pressure exerted by this liquid may force the valves 23 open against their springs 22 and thus pass downwardly through the space between tubing 10 and sleeve 11 thus reducing the height and consequently the weight of the column of liquid between the casing and the tubing above the packer, reducing the load carried by the packer, and avoiding any danger of collapsing the tubing. This bypassing of liquid from above the packer through

the packer can take place while seating surface 19 remains in engagement with valve seat 17 and while the "Christmas tree" remains on the tubing.

If it should be desired to replace the heavy circulation fluid between the tubing and the casing above the packer with a liquid that is lighter than the circulation fluid, this may be easily accomplished by forcing the lighter liquid such as oil into the casing, thus forcing the circulation fluid downwardly through the passages 20 and past the upwardly closing check valves 23. That all of the circulation fluid has been replaced by oil can be readily determined by watching for the return of oil through the tubing at the surface. It will be understood that in this operation the circulation fluid is first forced downwardly past the check valves 23 and through the passages 20 and through the packer. It then passes upwardly through the tubing. During this operation, as before the "Christmas tree" remains installed and the tubing 10 undisturbed at all times so that the well is under control.

Whenever there is sufficient formation pressure in the well this is automatically retained by the packer inasmuch as the valves 23 are automatically closed by their springs whenever the pressures above and below the packer are closely enough equalized to permit the springs to become effective.

Under certain circumstances it may be desirable to "kick the well over" or to flow the well by forcing gas below the packer to carry the oil up into the tubing. Either of these procedures may be readily accomplished by pumping gas into the casing which displaces the liquid between the casing and the tubing above the packer in a downward direction. The gas ultimately follows this displaced liquid and passes downwardly through the packer past the check valves 23 and finally enters the bottom of the tubing bringing about a flowing of the well if there is sufficient formation pressure to cause the well to flow or elevating oil through the tubing on the principle of a gas lift. Even under these conditions the "Christmas tree" and tubing 10 remain undisturbed so that the well is always under control. In some wells there is a tendency for the well to sand up below the packer, and in this event by forcing liquid downwardly between the casing and the tubing and through the passages 20 circulation may be maintained sufficiently to wash the accumulated sand into the tubing and thus cause it to be expelled from the well with the ascending column of liquid in the tubing.

The packer embodying the automatic bypass valve can thus be used under a variety of different conditions wherein it is desirable to force liquid downwardly through the packer around the tubing without disturbing the packer, the tubing, or the "Christmas tree" thereon.

In Figs. 4, 5, and 6, the invention has been illustrated as having been applied to another type of packer. In this form the tubing is generally designated at 30 surrounding which there is a sleeve or shell 31 in spaced relation thereto. The packing rings 32 constitute the packing means surrounding the shell above the slip cone 33. On the tubing there is a collar 34 which, when the weight of the tubing is imposed thereon, compresses and expands the packing rings 32. Passages 35 are formed through the collar and communicate with the space 36 between the sleeve 31 and the tubing 30. These passages are equipped with upwardly closing check valves or bolts 37 urged into uppermost positions by means of springs 38 against seats 39. In this form of construction which may be advantageously used for "kicking the well over" or flow a well by means of compressed gas it is desirable to provide relatively long, small tubes 40 extending upwardly from the valve seats 39. These tubes are equipped with inlets 41 adjacent their upper ends. A cylindrical screen 42 is mounted between collar 34 and collar 43 which latter collar sockets the upper ends of the tubes. By having the tubes of the required length and required small diameter the volumetric flow of gas therethrough can be controlled. Thus, by having these tubes quite long and of relatively small diameter the amount of gas that can be forced therethrough during any period of time will be relatively small. By shortening the tubes or increasing their diameters the rate of flow of gas therethrough may be increased. In this way the volume of gas permitted to pass through the packer can be varied for various conditions that may be encountered in the well. It will be understood that the packer shown in Figs. 4, 5, and 6 may be utilized to accomplish the same results as above described in connection with the construction illustrated in Figs. 1, 2 and 3.

From the above-described constructions it will be appreciated that the automatic bypass valve is a very simple and durable construction and may be applied to virtually any type of oil well packer. Although downward flow may take place through the packer at any time and under any conditions without disturbing the tubing or removing the "Christmas tree," upward flow through the packer except through the tubing is automatically prevented so that the formation pressure below the packer will be preserved at all times.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A well packer having a longitudinal passage therethrough to permit upward passage of well fluid, and means including one or more check valves permitting downward flow through the packer around said passage but preventing flow in the opposite direction.

2. The combination with a packer having a packing means, a sleeve within the packing means, a tubing within the sleeve and a valve on the tubing adapted to seat on the sleeve, one or more passages through the valve for permitting flow through the valve when the valve is seated to the space between the tubing and the sleeve, and upwardly closing check valves in the passages.

3. The combination with a packer having a packing means, a sleeve within the packing means, a tubing within the sleeve and a valve on the tubing adapted to seat on the sleeve, one or more passages through the valve for permitting flow through the valve when the valve is seated to the space between the tubing and the sleeve, upwardly closing check valves in the passages, and screen means arranged over the upper ends of the passages.

4. An automatic bypass for packers comprising a valve adapted to be attached to the tubing and adapted to engage the packer to close the passage therethrough about the tubing, there being a passage through the valve to permit downward flow through the packer while the valve is seated,

and check valve means for preventing upward flow through said passage.

5. An automatic bypass for packers comprising a valve adapted to be attached to the tubing and adapted to engage the packer to close the passage therethrough about the tubing, there being a passage through the valve to permit downward flow through the packer while the valve is seated, check valve means for preventing upward flow through said passage, and screen means over the upper end of the passage.

6. In combination with a packer having a tubing extending therethrough and a valve on the tubing engageable with the packer, of a bypass through the valve equipped with check valve means whereby downward flow through the valve may take place past the check valve means while the valve is seated but upward flow through the valve is prevented.

7. An automatic bypass valve for packers compising a valve body having a seating surface, one or more passages formed through the valve body inwardly of the seating surface and upwardly closing check valves in said passages.

8. An automatic bypass valve for packers comprising a valve body having a seating surface, one or more passages formed through the valve body inwardly of the seating surface and upwardly closing check valves in said passages, and a screen secured over the valve body for screening fluid that may be forced downwardly through the passages.

9. In combination with a packer having a tubing extending therethrough and a passage around the tubing designed to remain open while the packer is being lowered into the well, a valve on the tubing adapted to close said passage through the packer when the packer is set, passages through the valve permitting downward flow through the packer while the packer is set, and upwardly closing check valve means in said passages.

10. A well packer having packing means, a sleeve within the packing means, a tubing within the sleeve in spaced relation thereto, and upwardly closing check valves permitting downward flow between the sleeve and the tubing but preventing upward flow between the sleeve and the tubing.

11. A well packer having packing means, a sleeve within the packing means, a tubing within the sleeve in spaced relation thereto, upwardly closing check valves permitting downward flow between the sleeve and the tubing but preventing upward flow between the sleeve and the tubing, and tubes leading to said check valves for controlling the flow therethrough.

12. A well packer having packing means, a sleeve within the packing means, a tubing within the sleeve in spaced relation thereto, upwardly closing check valves permitting downward flow between the sleeve and the tubing but preventing upward flow between the sleeve and the tubing, tubes leading to said check valves for controlling the flow therethrough, and a screen surrounding said tubes.

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